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SEMI-ANNUAL CORRECTIVE ACTION ASSESSMENT REPORT FOR SITE 11 OCTOBER
2000 - APRIL 2001 NSB KINGS BAY GA
4/30/2001
J A JONES MANAGEMENT SERVICES

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19.49.00.0022



Semi-Annual Corrective Action Assessment Report

**October 2000 – March 2001
FINAL**

**Site 11, Old Camden County Landfill
Naval Submarine Base Kings Bay, Georgia**

**Prepared for:
Naval Submarine Base
Kings Bay, Georgia
Facilities and Environmental Directorate**

Prepared by:



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Kings Bay, Georgia 31547**



SEMI-ANNUAL CORRECTIVE ACTION ASSESSMENT REPORT

October 2000 – March 2001
FINAL

SITE 11, OLD CAMDEN COUNTY LANDFILL
NAVAL SUBMARINE BASE KINGS BAY, GEORGIA

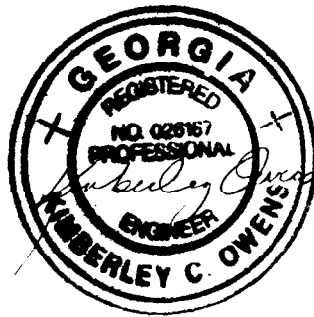
Prepared for:

NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA
FACILITIES AND ENVIRONMENTAL DIRECTORATE

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The work described and professional opinions rendered in this document, *Semiannual Corrective Action Assessment Report October 2000 – March 2001, Site 11, Old Camden County Landfill, Naval Submarine Base Kings Bay, Georgia* were conducted and developed using commonly accepted procedures consistent with applicable standards of practice. The scope of services and activities described in this document were developed under the supervision of a professional geologist registered in the State of Georgia as certified in the *Status Memorandum, Site 11, Old Camden County Landfill, Naval Submarine Base, Kings Bay, March 2001*.



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ATTACHMENT 1

Status Memorandum, Site 11, Old Camden County Landfill, Naval Submarine Base, Kings Bay, March 2001

ACRONYMS

| | |
|-------|--------------------------------|
| JAJMS | J.A. Jones Management Services |
| BEI | Bechtel Environmental, Inc. |
| CCI | CH2M HILL Constructors, Inc. |
| Bls | Below land surface |
| NSB | Naval Submarine Base |

UNITS OF MEASURE

| | |
|-----------------|----------------------|
| Ft | Foot |
| Gal | Gallon |
| Lb | Pounds |
| In. | Inch |
| MSL | Mean sea level |
| $\mu\text{g/L}$ | Micrograms per liter |
| ppb | Parts per billion |
| ppm | Parts per million |
| sf | Square foot |

1.0 INTRODUCTION

J.A. Jones Management Services (JAJMS) has been contracted by the Department of the Navy, Submarine Base Kings Bay to provide groundwater monitoring services at Site 11, Old Camden County Landfill at the Naval Submarine Base (NSB) Kings Bay.

This Semi-annual Corrective Action Assessment Report summarizes the quarterly monitoring activities and remediation progress from October 1, 2000 to March 30, 2001. The report presents a summary of: 1) the source delineation sampling and analysis activities; 2) the quarterly groundwater monitoring; 3) overall status of remediation; and 4) projected work for the next reporting period.

2.0 SUMMARY OF ACTIVITIES

During this reporting period, a source area delineation effort was conducted to determine the horizontal and vertical extent of contamination beneath the Phase III chemical oxidation treatment injectors (60 series). Quarterly groundwater sampling and analyses of monitoring wells was conducted for compliance with the Groundwater Protection Standards in accordance with the RCRA permit. Analytical results are discussed in section 3.0.

2.1 SOURCE AREA DELINEATION

CH2M HILL Constructors, Inc. (CCI) with J.A. Jones Environmental Services Company (J.A. Jones) performed a source area delineation effort to delineate the horizontal and vertical extent of the contamination beneath the Phase III chemical oxidation treatment injectors (60 series). This work was a follow-up to the recommendations in the *Completion Report for In-Situ Chemical Oxidation, Site 11 Old Camden County Landfill, Naval Submarine Base, Kings Bay, Georgia (BEI,2000a)*.

From November 6-21, 2000, the source area delineation effort was completed using a membrane interface probe (MIP)/Geoprobe rig with an onsite mobile laboratory. Initially, groundwater samples were collected on a horizontal 10-foot grid from Injector I-60, but based on the initial groundwater sampling results, the spacing was increased to a 50-foot grid to locate a "clean" boundary.

From January 8-12, 2001, the source area delineation effort was completed using a Geoprobe rig with an offsite laboratory. Groundwater samples were collected on a 25-foot grid centered five feet to the west of Injector I-60 with samples collected from each of nine borings at depths of 36-40 feet below land surface (bls), 40-44 feet bls, 44-48 feet bls, and 48-52 feet bls.

The groundwater sample collection locations are shown on Figures 2-1 and 2-2 in Attachment 1 (*Status Memorandum, Site 11, Old Camden County Landfill, Naval Submarine Base, Kings Bay, March 2001*).

2.2 GROUNDWATER MONITORING WELLS

Quarterly groundwater sampling was conducted by JAJMS on November 8, 2000 and February 6-8, 2001. The November 2000 sampling and analytical results are detailed in the *Quarterly Groundwater Monitoring Report, September-November 2000, Site 11 Old Camden County Landfill Naval Submarine Base Kings Bay Georgia (JAJMS 2000a)*. The February 2001 sampling and analytical results are detailed in the *Quarterly Groundwater Monitoring Report, December 2000-February 2001, Site 11 Old Camden County Landfill Naval Submarine Base Kings Bay Georgia (JAJMS 2000b)*.

3.0 ANALYTICAL DATA

This section provides a summary of the analytical results associated with sampling and analyses efforts for the source area delineation and the quarterly groundwater monitoring well activities. All samples associated with the source area delineation were either analyzed onsite or submitted to Severn Trent Laboratories for chemical analyses. All samples associated with the quarterly groundwater monitoring wells were submitted to Columbia Analytical Laboratories. Quality assurance and quality control was maintained through collection of duplicate samples and conformance with the laboratory's Comprehensive Quality Assurance Manual for Contract Laboratories.

3.1 SOURCE AREA DELINEATION

The analytical results from the November 2000 source area delineation effort are provided in Table 1-1 in Attachment 1. Based on these results, the vertical interval of contamination in the source area was determined to be from 44 to 48 feet bls.

The analytical results from the January 2001 source area delineation effort are provided in Table 1-2 in Attachment 1. These results provided sufficient data to determine the horizontal extent of contamination.

3.2 GROUNDWATER MONITORING WELLS

Six (6) groundwater monitoring wells were sampled and analyzed for Groundwater Protection Standard constituents on November 8, 2000 and again on February 6-8, 2001. Five of the six wells (KBA-11-13A, KBA-11-16A, KBA-11-34, KBA-11-37, PS-2) exceeded the Groundwater Protection Standards for one or more of the constituents. This data is presented in Table 1.

4.0 STATUS OF REMEDIATION

The purpose of the activities conducted during this semi-annual report were to delineate the source area contamination beneath the 60 series injectors and to continue quarterly groundwater monitoring.

4.1 GROUNDWATER

Water level elevations were calculated for the February 2001 quarterly sampling event of the groundwater monitoring wells. Figure 1 depicts the groundwater elevations for this period.

4.2 CHLORINATED CONSTITUENT ISOPLETHS

Chlorinated concentration isopleths were developed for total chlorinated ethenes for the November 2000 source delineation effort. Figure 2 shows two areas of highest contamination around SP-01 and SP-35.

4.3 QUANTITY OF CHLORINATED HYDROCARBONS REMOVED

A chemical oxidation injection and associated sampling and analysis did not occur during October 2000 to April 2001; therefore, the quantity of hydrocarbons removed was not calculated.

5.0 PROJECTED WORK FOR THE NEXT REPORTING PERIOD

The next project objective is to utilize the analytical data collected during the source area delineation effort to design and implement a Fenton's reagent chemical oxidation and vegetable oil injection strategy to remediate the groundwater contamination located in the delineated source area at Site 11. At this time, the strategy is being developed and site remediation is scheduled for May 2001.

JAJMS will continue to conduct the quarterly groundwater monitoring in accordance with the RCRA Permit.

6.0 REFERENCES

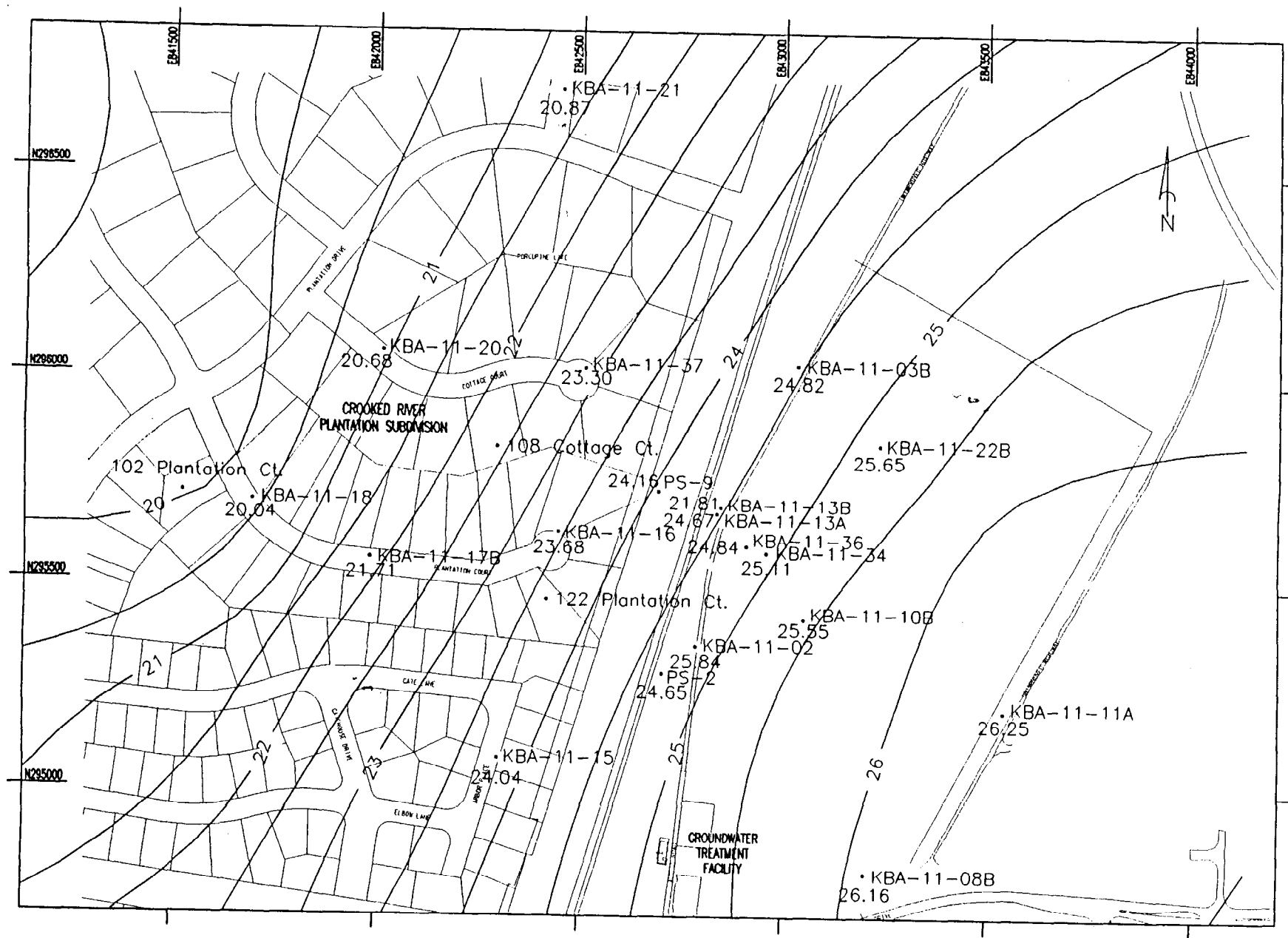
The following references were used in this report:

Quarterly Groundwater Monitoring Report, September-November 2000, Site 11 Old Camden County Landfill Naval Submarine Base Kings Bay Georgia (JAJMS 2000a).

Quarterly Groundwater Monitoring Report, December 2000-February 2001, Site 11 Old Camden County Landfill Naval Submarine Base Kings Bay Georgia (JAJMS 2000b).

*Completion Report for In-Situ Chemical Oxidation, Site 11 Old Camden County Landfill,
Naval Submarine Base, Kings Bay, Georgia (BEI 2000a).*

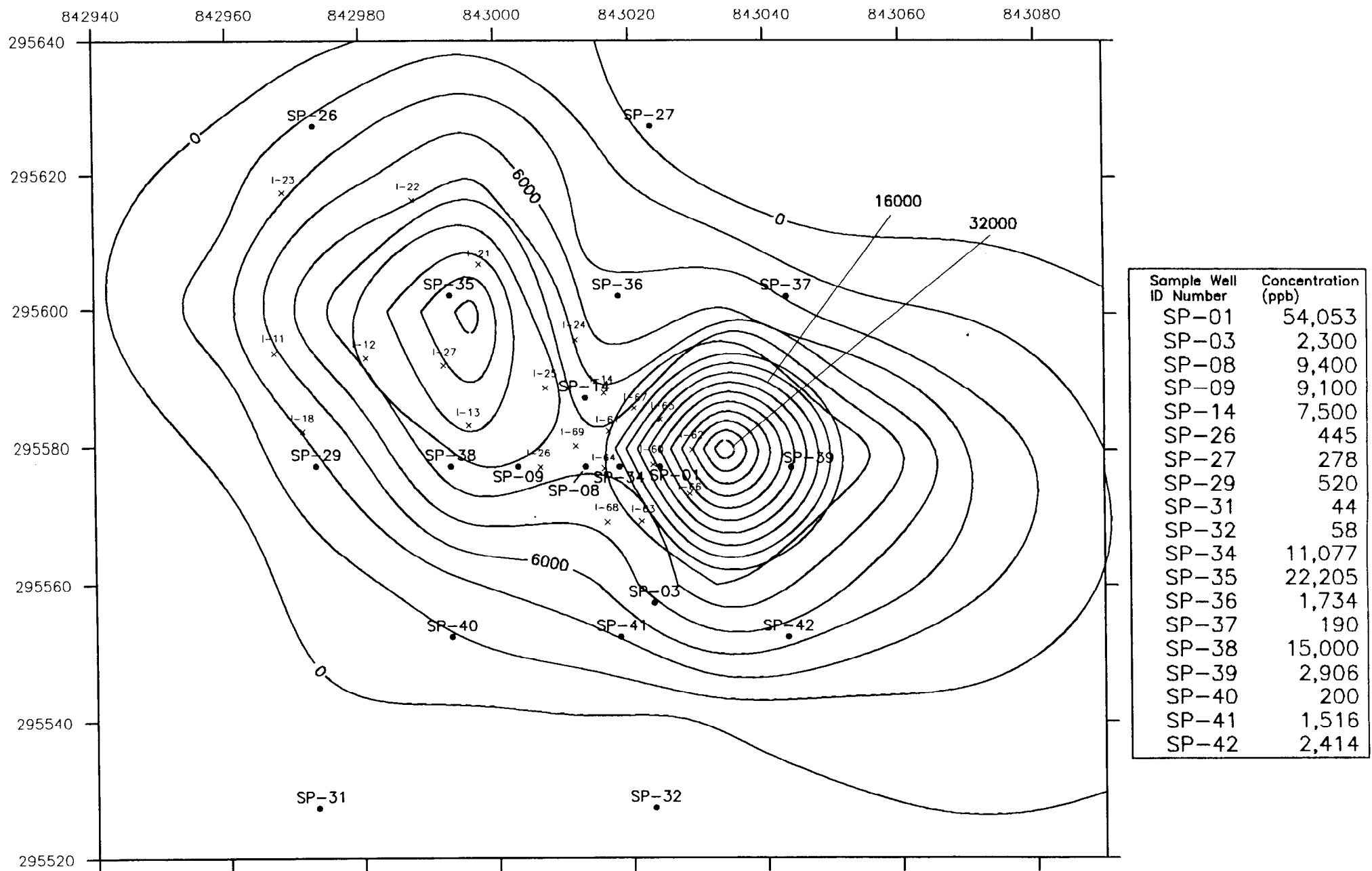
FIGURES



Groundwater Elevation Map-February 2001

Contour Interval=0.5 ft

FIGURE 1: Groundwater Elevation Map-February 2001



Source Area Delineation Results

Fig. 2 -Total Chlorinated Ethenes (ppb) November 2000

Contour Interval = 2000 ppb

TABLES

Table 1
Analytical Summary, Groundwater Protection Standard

| Groundwater Protection Standard | Criteria (µg/L) | KBA-11-02 | | | | | | | KBA-11-10B | | KBA-11-11A | |
|---------------------------------|-----------------|---------------|----------------|-----------------------------|---------------|---------------|----------------|---------------|---------------|---------------|----------------|---------------|
| | | <u>2-6-01</u> | <u>11-8-00</u> | <u>8-8-00</u> | <u>5-3-00</u> | <u>2-4-00</u> | <u>11-9-99</u> | <u>8-3-99</u> | <u>8-8-00</u> | <u>8-2-99</u> | <u>8-10-00</u> | <u>8-2-99</u> |
| Tetrachloroethene | 5.0 | 1.0U | 1.0U | Unable to sample – no water | 1.0U | 1.0U | 3.0U | 3.0U | 1.0U | 3.0U | 1.0U | 3.0U |
| Trichloroethene | 5.0 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Cis -1,2-dichloroethene | 70 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0 | 1.6I | 1.0U | 1.0U |
| Trans-1,2-dichloroethene | 100 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethene | 7.0 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethane | 1.0 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,2-dichloroethane | 5.0 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Vinyl Chloride | 2.0 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Chloroethane | 1.0 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Benzene | 5.0 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0 | 1.6 | 1.0U | 1.0U |
| Ethylbenzene | 700 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 5.0 | 10 | 1.0U | 1.0U |
| Toluene | 1,000 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Total xylenes | 10,000 | 3.0U | 3.0U | NS | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 1.0U | 3.0U |
| Chlorobenzene | 1.0 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0 | 2.5 | 1.0U | 1.0U |
| 1,4-dichlorobenzene | 75 | 1.0U | 1.0U | NS | 1.0U | 1.0U | 1.0U | 1.0U | 1.0 | 1.5 | 1.0U | 1.0U |

Notes: I = interference.

J = estimated value; analyte detected; value is between the method detection level (MDL) and the practical quantitation level (PQL).

U = compound was analyzed for but not detected to the level shown.

BOLD indicates result exceeds the groundwater protection standard.

Table 1 Continued
Analytical Summary, Groundwater Protection Standard

| Groundwater Protection Standard | Criteria (µg/L) | KBA-11-13A | | | | | | | | | KBA-11-13B | |
|---------------------------------|-----------------|------------|---------|---------|---------------------|--------|--------|---------|---------------------|--------|------------|--------|
| Date | | 2-8-01 | 11-8-00 | 8-10-00 | 8-10-00 (Duplicate) | 5-3-00 | 2-4-00 | 11-9-99 | 11-9-99 (Duplicate) | 8-3-99 | 8-8-00 | 8-3-99 |
| Tetrachloroethene | 5.0 | 0.8 | 3.0U | 1.0U | 1.0U | 1.0U | 1.0U | 30U | 3.0U | 3.0U | 1.0U | 3.0U |
| Trichloroethene | 5.0 | 45.0 | 54.0 | 51.0 | 40.0 | 20.0 | 14.0 | 15I | 17 | 19 | 1.0U | 1.0U |
| Cis -1,2-dichloroethene | 70 | 110 | 160 | 300 E | 190 | 180 | 230 | 260 | 210 | 190 | 1.0U | 1.0U |
| Trans-1,2 dichloroethene | 100 | 8.0 | 7.0 | 9.0 | 7.0 | 6.0 | 6.0 | 1.0U | 6.6 | 7.4 | 1.0U | 1.0U |
| 1,1-dichloroethene | 7.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethane | 1.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,2-dichloroethane | 5.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Vinyl Chloride | 2.0 | 0.9 | 4.0 | 17.0 | 11.0 | 19.0 | 20.0 | 46 | 42 | 48 | 1.0U | 1.0U |
| Chloroethane | 1.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Benzene | 5.0 | 1.0 | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 | 1.0U | 1.3I | 1.1I | 1.0U | 1.0U |
| Ethylbenzene | 700 | 34 | 57 | 71 | 51.0 | 67 | 64.0 | 65 | 92 | 66 | 1.0U | 1.0U |
| Toluene | 1,000 | 1.0U | 1.0U | 0.9 | 0.7 | 2.0 | 2.0 | 1.0U | 4.2 | 2.7 | 1.0U | 1.0U |
| Total xylenes | 10,000 | 3.0U | 2.0U | 0.7 | 3.0 | 4.0 | 23.0 | 24I | 49 | 14.4 | 3.0U | 3.0U |
| Chlorobenzene | 1.0 | 3.0 | 5.0 | 5.0 | 4.0 | 5.0 | 6.0 | 1.0U | 8.2 | 6.2 | 1.0U | 1.0U |
| 1,4-dichlorobenzene | 75 | 1.0U | 3.0 | 3.0 | 2.0 | 3.0 | 4.0 | 1.0U | 5.2 | 4.0 | 1.0U | 1.0U |

Notes: I = interference.

J = estimated value; analyte detected; value is between the method detection level (MDL) and the practical quantitation level (PQL).

U = compound was analyzed for but not detected to the level shown.

BOLD indicates result exceeds the groundwater protection standard.

Table 1 Continued
Analytical Summary, Groundwater Protection Standard

| Groundwater Protection Standard | Criteria (µg/L) | KBA-11-15 | | | | KBA-11-16 | | | | | | | |
|---------------------------------|-----------------|---------------|---------------|------------------------------|---------------|---------------|----------------|---------------|---------------|------------------------------|---------------|----------------|---------------|
| | | <u>8-9-00</u> | <u>2-7-00</u> | <u>2-7-00</u> (Duplicate) | <u>8-3-99</u> | <u>2-6-01</u> | <u>11-8-00</u> | <u>8-9-00</u> | <u>5-4-00</u> | <u>5-4-00</u> (Duplicate) | <u>2-7-00</u> | <u>11-9-99</u> | <u>8-3-99</u> |
| Tetrachloroethene | 5.0 | 1.0U | 1.0 | 1.0 | 3.0U | 1.0U | 2.0 | 1.0U | 1.0U | 1.0U | 1.0U | 3.0U | 3.0U |
| Trichloroethene | 5.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Cis -1,2-dichloroethene | 70 | 1.0U | 0.9I | 1.0 | 1.0U | 34.0 | 8.0 | 2.0 | 2.0 | 2.0 | 14.0 | 3.6 | 1.0U |
| Trans-1,2 dichloroethene | 100 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethene | 7.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethane | 1.0 | 1.0U | 1.0U | 1.0U | 1.0U | 11.0 | 2.0 | 2.0 | 1.0U | 0.6U | 5.0 | 1.6I | 1.0U |
| 1,2-dichloroethane | 5.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Vinyl Chloride | 2.0 | 1.0U | 1.0U | 1.0U | 1.0U | 4.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0 | 1.4I | 1.0U |
| Chloroethane | 1.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Benzene | 5.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Ethylbenzene | 700 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 0.8J | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Toluene | 1,000 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 3.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Total xylenes | 10,000 | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U |
| Chlorobenzene | 1.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,4-dichlorobenzene | 75 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |

Notes: I = interference.

J = estimated value; analyte detected; value is between the method detection level (MDL) and the practical quantitation level (PQL).

U = compound was analyzed for but not detected to the level shown.

BOLD indicates result exceeds the groundwater protection standard.

Table 1 Continued
Analytical Summary, Groundwater Protection Standard

| Groundwater Protection Standard | Criteria (µg/L) | KBA-11-17B | | | KBA-11-34 | | | | | | |
|---------------------------------|-----------------|---------------|---------------|---------------|---------------|----------------|---------------|---------------|---------------|----------------|---------------|
| | | <u>8-9-00</u> | <u>2-7-00</u> | <u>8-3-99</u> | <u>2-8-01</u> | <u>11-8-00</u> | <u>8-9-00</u> | <u>5-4-00</u> | <u>2-7-00</u> | <u>11-9-99</u> | <u>8-3-99</u> |
| Tetrachloroethene | 5.0 | 1.0U | 1.0U | 3.0U | 73.0 | 79.0 | 63.0 | 89.0 | 83.0 | 22 | 17 |
| Trichloroethene | 5.0 | 1.0U | 1.0U | 1.0U | 2.0 | 1.0U | 0.6J | 1.0 | 2.0 | 1.0U | 1.0U |
| Cis -1,2-dichloroethene | 70 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Trans-1,2 dichloroethene | 100 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethene | 7.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethane | 1.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,2-dichloroethane | 5.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Vinyl Chloride | 2.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Chloroethane | 1.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Benzene | 5.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Ethylbenzene | 700 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Toluene | 1,000 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Total xylenes | 10,000 | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U | 3.0U |
| Chlorobenzene | 1.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,4-dichlorobenzene | 75 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |

Notes: I = interference.

J = estimated value; analyte detected; value is between the method detection level (MDL) and the practical quantitation level (PQL).

U = compound was analyzed for but not detected to the level shown.

BOLD indicates result exceeds the groundwater protection standard.

Table 1 Continued
Analytical Summary, Groundwater Protection Standard

| Groundwater Protection Standard | Criteria (µg/L) | KBA-11-37 | | | | | | | | |
|---------------------------------|-----------------|-----------|--------|---------|---------------------|--------|--------|--------|---------|---------|
| | | Date | 2-7-01 | 11-8-00 | 11-8-00 (Duplicate) | 8-9-00 | 5-4-00 | 2-8-00 | 11-9-99 | 8-16-99 |
| Tetrachloroethene | 5.0 | | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 3.0U | 3.0U |
| Trichloroethene | 5.0 | | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Cis -1,2-dichloroethene | 70 | | 13.0 | 11.0 | 11.0 | 14.0 | 17.0 | 16.0 | 17 | 24 |
| Trans-1,2 dichloroethene | 100 | | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethene | 7.0 | | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethane | 1.0 | | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,2-dichloroethane | 5.0 | | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Vinyl Chloride | 2.0 | | 0.6J | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.4I | 2.5I |
| Chloroethane | 1.0 | | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Benzene | 5.0 | | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.1 |
| Ethylbenzene | 700 | | 13.0 | 10.0 | 11.0 | 7.0 | 1.0U | 9.0 | 14 | 15 |
| Toluene | 1,000 | | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0 | 1.0U | 1.0U |
| Total xylenes | 10,000 | | 3.0U | 2.0U | 2.0U | 3.0 | 12.0 | 3.0U | 3.0U | 3.0U |
| Chlorobenzene | 1.0 | | 2.0 | 3.0 | 3.0 | 2.0 | 3.0 | 2.0 | 3.1 | 2.9 |
| 1,4-dichlorobenzene | 75 | | 1.0U | 4.0 | 3.0 | 3.0 | 3.0 | 3.0 | 4.7 | 3.6 |

Notes: I = interference.

J = estimated value; analyte detected; value is between the method detection level (MDL) and the practical quantitation level (PQL).

U = compound was analyzed for but not detected to the level shown.

BOLD indicates result exceeds the groundwater protection standard.

Table 1 Continued
Analytical Summary, Groundwater Protection Standard

| Groundwater Protection Standard | Criteria (µg/L) | PS-2 | | | | | | |
|---------------------------------|-----------------|--------|---------|--------|--------|--------|---------|---------|
| Date | | 2-7-01 | 11-8-00 | 8-8-00 | 5-3-00 | 2-7-00 | 11-9-99 | 8-18-99 |
| Tetrachloroethene | 5.0 | 1.0U | 3.0U | 1.0U | 1.0U | 1.0U | 3.0U | 3.0U |
| Trichloroethene | 5.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 1.4I | 1.3I |
| Cis -1,2-dichloroethene | 70 | 71.0 | 61.0 | 58.0 | 57.0 | 52.0 | 40 | 41 |
| Trans-1,2 dichloroethene | 100 | 0.6J | 1.0U | 1.0U | 0.5 | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethene | 7.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| 1,1-dichloroethane | 1.0 | 4.0 | 4.0 | 4.0 | 5.0 | 5.0 | 5.1 | 5.6 |
| 1,2-dichloroethane | 5.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Vinyl Chloride | 2.0 | 3.0 | 3.0 | 2.0 | 1.0U | 2.0 | 2.9 | 3.2I |
| Chloroethane | 1.0 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |
| Benzene | 5.0 | 4.0 | 5.0 | 6.0 | 8.0 | 8.0 | 9.4 | 9.1 |
| Ethylbenzene | 700 | 18.0 | 18.0 | 14.0 | 16.0 | 14.0 | 16 | 10 |
| Toluene | 1,000 | 3.0 | 5.0 | 8.0 | 19.0 | 37.0 | 57 | 43 |
| Total xylenes | 10,000 | 4.0 | 7.0 | 19.0 | 41.0 | 40.0 | 47 | 29 |
| Chlorobenzene | 1.0 | 0.5J | 1.0 | 0.5 | 0.7 | 1.0U | 1.0U | 1.0U |
| 1,4-dichlorobenzene | 75 | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U | 1.0U |

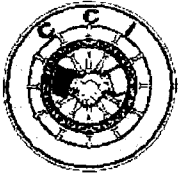
Notes: I = interference.

J = estimated value; analyte detected; value is between the method detection level (MDL) and the practical quantitation level (PQL).

U = compound was analyzed for but not detected to the level shown.

BOLD indicates result exceeds the groundwater protection standard.

ATTACHMENT 1

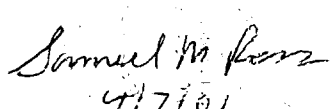


CCI NAVY RAC

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The work described and professional opinions rendered in this document, *Status Memorandum, Site 11, Old Camden County Landfill, Naval Submarine Base Kings Bay, Georgia*, dated March 19, 2001, were conducted and developed using commonly accepted procedures consistent with applicable standards of practice. The scope of services and activities described in this document were developed under the supervision of a professional engineer registered in the State of Georgia.

NAME AND TITLE OF CERTIFYING OFFICIAL:


417781

Samuel M. Ross
Senior Project Manager
CCI/J.A. Jones Navy RAC
Georgia P.E. Number 024706
Expires December 31, 2002

**STATUS MEMORANDUM
SITE 11, OLD CAMDEN COUNTY LANDFILL
NAVAL SUBMARINE BASE KINGS BAY
KINGS BAY, GEORGIA**

1.0 INTRODUCTION

CH2M HILL Constructors, Inc. (CCI), with J.A. Jones Environmental Services Company (J.A. Jones) have been contracted by the Department of the Navy, Southern Division Naval Facilities Engineering Command (Southern Division, NAVFAC), to perform source area delineation and groundwater remediation at Site 11, Old Camden County Landfill, Naval Submarine Base (NSB) Kings Bay, Georgia, under the Remedial Action Contract No. N62467-98-D-0995, Contract Task Order (CTO) No. 0047. The purpose of this Status Memorandum is to provide a summary of remediation activities performed to date at the site.

The scope of work under this CTO was to delineate the horizontal and vertical extent of the potential source area tetrachloroethene (PCE) contamination (and its degradation products) beneath the existing Phase III chemical oxidation treatment injectors, and utilize this data to design and implement a groundwater remediation strategy for the delineated source area.

2.0 SITE HISTORY

NSB Kings Bay occupies approximately 16,168 acres in Camden County, Georgia. Site 11 is identified as the Old Camden County Landfill, which is now incorporated in NSB Kings Bay. The Old Camden County Landfill was used for municipal solid waste disposal in the 1960s and 1970s. Waste was disposed of by digging trenches, filling the trenches with waste, and then backfilling the trenches with fill. PCE was disposed in the landfill at some point during waste disposal activities, which resulted in groundwater contamination at the site. The contaminants of concern at Site 11 include chlorinated volatile organic compounds (VOCs), specifically PCE, and its degradation constituents trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride (VC).

Bechtel Environmental, Inc. (BEI), with Geo-Cleanse International, Inc., performed three phases of chemical oxidation treatment during August 1998 through April 2000. During the entire treatment program, a total of 54 injectors were installed and an approximate total of 34,850 gallons of 50 percent hydrogen peroxide and an equivalent amount of ferrous iron catalyst were delivered to the subsurface.

Phase I chemical oxidation treatment was performed from August 1998 through February 1999. Because of a concentration increase in three piezometers and Injector I-14 following Phase I treatment, BEI conducted a cone penetration testing program in April 1999 to confirm and delineate the horizontal extent of dissolved groundwater contamination.

Phase II chemical oxidation treatment was performed from May 1999 to July 1999 on areas east and west of the Phase I area of concern. Because of a concentration rebound in Injector I-14 following the Phase II treatment, BEI conducted a Geoprobe investigation in August 1999 to investigate and locate the potential new source of PCE at Injector I-14. Excavation of the suspected source area near Injector I-14 was conducted in September 1999. The excavation yielded several 5-gallon containers, one containing a gray-colored, paint looking waste, and one approximate 20-gallon container containing a black sludge type waste. The black waste showed PCE with the highest concentration of all compounds tested.

**STATUS MEMORANDUM
SITE 11, OLD CAMDEN COUNTY LANDFILL
NAVAL SUBMARINE BASE KINGS BAY
KINGS BAY, GEORGIA**

Phase III chemical oxidation treatment was performed from January 2000 to April 2000 on the delineated source area southeast of Injector I-14. Based on the analytical results from the post-Phase III sampling event conducted on May 30, 2000, a source area of PCE contamination appears to remain beneath the Phase III injectors.

3.0 SUMMARY OF REMEDIATION ACTIVITIES

A source area delineation effort was conducted by CCI/J.A. Jones from November 6, 2000 through January 12, 2001 to delineate the horizontal and vertical extent of the potential source area PCE contamination (and its degradation products) beneath the Phase III chemical oxidation treatment injectors.

November 6 - 21, 2000 Source Area Delineation Effort

From November 6-21, 2000, the source area delineation effort was completed utilizing a membrane interface probe (MIP)/Geoprobe rig with an onsite mobile laboratory. The MIP technology was utilized to provide a vertical profile of the subsurface on a horizontal 10-foot grid from Injector I-60. The MIP is pushed into the ground using the Geoprobe rig at a rate of one-foot per minute. A soil conductivity sensor on the probe continuously logs the changes in the subsurface conductivity. A thermister on the probe heats the surrounding soil and water, which volatilizes the contaminants causing them to migrate across a permeable membrane and into the probe. A carrier gas transports the volatilized gases to a lab-grade gas chromatograph (GC) at the surface. The GC results log continuously into a computer and display real time. The MIP data was used to determine the groundwater sample collection locations and intervals. The groundwater sample collection locations are shown on Figures 2-1 and 2-2 provided in Attachment 2 and the MIP data and groundwater sample collection intervals and onsite mobile laboratory analytical results are provided in Table 1-1 in Attachment 1.

Initially, groundwater samples were collected on a horizontal 10-foot grid from Injector I-60, but based on the initial groundwater sample analytical results, the spacing was increased to a 50-foot grid to locate a "clean" boundary. Groundwater samples were collected from each boring using the Geoprobe rig with peristaltic sampling pump and analyzed by the onsite mobile laboratory for United States Environmental Protection Agency (USEPA) SW-846 Method 8021B.

Each boring was abandoned immediately following MIP boring or groundwater sample collection by sealing the boring with grout from the bottom of the boring to the ground surface using a tremie pipe.

Based on the groundwater sample analytical results collected during this initial effort, the vertical interval of contamination in the source area was determined to be from 44 to 48 feet below land surface (bls), however, additional groundwater collection sampling and analysis was determined to be necessary to delineate the horizontal extent of contamination.

January 8 - 12, 2001 Source Area Delineation Effort

From January 8-12, 2001, the source area delineation effort was completed utilizing a Geoprobe rig with an offsite laboratory. Groundwater samples were collected on a 25-foot grid centered five feet to the west of Injector I-60 with samples collected from each

**STATUS MEMORANDUM
SITE 11, OLD CAMDEN COUNTY LANDFILL
NAVAL SUBMARINE BASE KINGS BAY
KINGS BAY, GEORGIA**

of nine borings at depths of 36-40 feet bls, 40-44 feet bls, 44-48 feet bls, and 48-52 feet bls and analyzed by an offsite laboratory for USEPA SW-846 Method 8021B.

The groundwater sample collection locations are shown on Figures 2-1 and 2-2 provided in Attachment 2 and the groundwater sample collection intervals and offsite laboratory analytical results are provided in Table 1-2 in Attachment 1.

Each boring was abandoned immediately following groundwater sample collection by sealing the boring with grout from the bottom of the boring to the ground surface using a tremie pipe.

This delineation effort, along with the initial effort, provided sufficient data to determine the horizontal extent of contamination and the area requiring remediation.

4.0 CONCLUSIONS

The current project objective is to utilize the analytical data collected during the source area delineation effort to design and implement a Fenton's reagent chemical oxidation and vegetable oil injection strategy to remediate the groundwater contamination located in the delineated source area at site 11. At this time, the strategy is being developed and mobilization for site remediation is scheduled for May 2001.

ATTACHMENT 1
TABLES

Table 1-1
Source Area Delineation Results
November 6 - 21, 2000

| Sample Location ID | Sample Collection Interval (feet/bbl) | Summary of Total Chlorinated Ethenes | | | | | TCHE | Total VOC | Maximum MIP Reading (uV) |
|-----------------------|--|--------------------------------------|-------------|---------------|------|--------|--------|-----------|-----------------------------|
| | | VC | cis-1,2-DCE | trans-1,2-DCE | PCE | PEB | | | |
| SP-01 | 20 to 24 | <2 | 17 | <2 | 24 | 61 | 102 | 102 | 1.6E+7/3.7E+6 |
| | 36 to 40 | <2 | 15 | <2 | 19 | 180 | 214 | 214 | 1.60E+07 |
| | 40 to 44 | <2 | <2 | <2 | 19 | 550 | 569 | 569 | 3.80E+06 |
| | 44 to 48 | <2 | 7 | <2 | 46 | 54,000 | 54,053 | 54,078 | 5.80E+06 |
| | 48 to 52 | <2 | 45 | <2 | 4 | 790 | 839 | 857 | 1.50E+06 |
| | 52 to 56 | <2 | 40 | <2 | <2 | 8 | 48 | 90 | -- |
| | 56 to 60 | <2 | 3 | <2 | <2 | 2 J | 5 | 27 | -- |
| SP-03 | 35 to 39 | <200 | <200 | <200 | <200 | 2,300 | 2,300 | 2,300 | 4.30E+06 |
| SP-07 | 44 to 48 | <2 | 71 | <2 | <2 | 2 J | 73 | 114 | -- |
| | 48 to 52 | <2 | 44 | <2 | <2 | 1 J | 45 | 102 | -- |
| SP-08 | 44 to 48 | <200 | <200 | <200 | <200 | 9,400 | 9,400 | 9,400 | 1E+7/3.5E+5 |
| | 48 to 52 | <20 | 48 | <20 | <20 | 2,900 | 2,948 | 3,019 | 1E+7/2.5E+5 |
| | 52 to 56 | <2 | 27 | <2 | <2 | 4 | 31 | 61 | -- |
| | 56 to 60 | <2 | 13 | <2 | <2 | 1 J | 14 | 37 | -- |
| SP-09 | 44 to 48 | <200 | <200 | <200 | <200 | 9,100 | 9,100 | 9,100 | 2.40E+06 |
| | 48 to 52 | <200 | <200 | <200 | <200 | 150 J | 150 | 150 | 1.50E+06 |
| SP-14 | 44 to 48 | <200 | <200 | <200 | <200 | 7,500 | 7,500 | 7,500 | 4.80E+06 |
| | 48 to 52 | <20 | 22 | <20 | <20 | 950 | 972 | 972 | 6.50E+06 |
| | 52 to 56 | <2 | 17 | <2 | <2 | 1 J | 18 | 47 | -- |
| SP-26 | 44 to 48 | <20 | 15 J | <20 | <20 | 430 | 445 | 445 | -- |
| SP-27 | 44 to 48 | <20 | 100 | <20 | <20 | 100 | 200 | 278 | -- |
| | 48 to 52 | <2 | 17 | <2 | <2 | <2 | 17 | 42 | -- |
| SP-29 | 44 to 48 | <200 | <200 | <200 | <200 | 300 | 300 | 300 | -- |
| | 48 to 52 | <200 | <200 | <200 | <200 | 520 | 520 | 520 | -- |
| SP-31 | 44 to 48 | <2 | 25 | <2 | <2 | <2 | 25 | 80 | -- |

Table 1-1
Source Area Delineation Results
November 6 - 21, 2000

| Sample Location ID | Sample Collection Interval (feet bls) | Summary of Total Chlorinated Ethenes | | | | | TCLE | Total VOCs | Maximum MIP Reading (uV) |
|--------------------|---------------------------------------|--------------------------------------|-------------|---------------|-----|-----|------|------------|--------------------------|
| | | VOC | cis-1,2-DCE | trans-1,2-DCE | TCE | PCE | | | |
| | 48 to 52 | <2 | 43 | <2 | 1 J | <2 | 44 | 138 | -- |
| SP-32 | 36 to 40 | <2 | <2 | <2 | <2 | <2 | -- | 15 | -- |
| | 41 to 45 | <2 | 3 | <2 | <2 | <2 | 3 | 47 | -- |
| | 46 to 50 | <2 | 58 | <2 | <2 | <2 | 58 | 189 | -- |

Notes:

J: J qualifier denotes the concentration is estimated.

bls: below land surface

DCE: Dichloroethene

TCE: Trichloroethene

PCE: Tetrachloroethene

TCLE: Total Chlorinated Ethenes

VOCs: Volatile Organic Compounds

MIP: Membrane Interface Probe

uV: microvolts

All concentrations reported in micrograms per liter (ug/L), unless otherwise noted.

TCLE is defined as the summation of PCE, TCE, DCE, and Vinyl Chloride.

Total VOCs is defined as the sum of all detected constituents by USEPA Method 8021B.

Table 1-2
Source Area Delineation Results
January 8 - 12, 2001

| Sample Location ID | Sample Collection Interval (feet/bls) | Summary of Total Chlorinated Ethenes | | | | | TCDE | Total VOCs |
|--------------------|---------------------------------------|--------------------------------------|-------------|---------------|--------|--------|----------|------------|
| | | VG | cis-1,2-DCE | trans-1,2-DCE | PCE | PCE | | |
| SP-34 | 36 to 40 | <39 | 900 | <64 | 430 | 5,300 | 6,630.0 | 6,630.0 |
| | 40 to 44 | <39 | 200 | <64 | <31 | 5,100 | 5,300.0 | 53.1 |
| | 44 to 48 | <39 | 77 J | <64 | <31 | 11,000 | 11,077.0 | 11,077.0 |
| | 48 to 52 | 3.7 | 46 | <0.64 | 0.5 J | 43 | 93.2 | 123.6 |
| SP-35 | 36 to 40 | 53 | 62 | 8.4 | 22 | 56 | 201.4 | 201.4 |
| | 40 to 44 | <3.9 | 37 | <6.4 | 33 | 1,300 | 1,370.0 | 1,375.9 |
| | 44 to 48 | <24 | 150 | <12 | 55 | 22,000 | 22,205.0 | 22,205.0 |
| | 48 to 52 | <3.9 | <0.47 | <0.64 | 25 | 460 | 485.0 | 496.0 |
| SP-36 | 36 to 40 | <0.39 | <0.47 | <0.63 | 0.38 J | 90 | 90.4 | 94.0 |
| | 40 to 44 | <3.9 | 24 | <6.4 | 10 | 1,700 | 1,734.0 | 1,742.3 |
| | 44 to 48 | 5.2 | 340 | 1.8 | 1.1 | 14 | 362.1 | 413.5 |
| | 48 to 52 | 2.9 | 14 | <0.23 | <0.22 | 0.42 J | 17.3 | 37.7 |
| SP-37 | 36 to 40 | 1.2 | 0.58 J | <0.23 | <0.22 | 6 | 7.8 | 13.4 |
| | 40 to 44 | 5.1 | 180 | 0.6 J | 0.47 J | 3.5 | 189.7 | 229.8 |
| | 44 to 48 | 1.3 | 17 | <0.23 | <0.22 | 3.7 | 22.0 | 36.2 |
| | 48 to 52 | 3.2 | 11 | <0.23 | 0.31 J | 3.8 | 18.3 | 36.7 |
| SP-38 | 36 to 40 | <0.39 | 6.5 | <0.64 | 7 | 130 | 143.5 | 144.9 |
| | 40 to 44 | <0.39 | 2.9 | <0.64 | 1.8 | 90 | 94.7 | 96.5 |
| | 44 to 48 | <39 | <47 | <64 | <31 | 15,000 | 15,000.0 | 15,000.0 |
| | 48 to 52 | <39 | <47 | <64 | <31 | 5,100 | 5,100.0 | 5,100.0 |

Table 1
Source Area Delineation Results
January 8 - 12, 2001

| Sample Location ID | Sample Collection Interval (feet bls) | Summary of Total Chlorinated Ethenes | | | | | TCLE | Total VOCs |
|--------------------|---------------------------------------|--------------------------------------|-------------|---------------|--------|--------|---------|------------|
| | | VOC | cis-1,2-DCE | trans-1,2-DCE | TCE | PCE | | |
| SP-39 | 36 to 40 | <3.9 | <4.7 | <6.4 | 4.3 J | 1,800 | 1,804.3 | 1,804.3 |
| | 40 to 44 | <3.9 | <4.7 | <6.4 | 5.6 J | 2,900 | 2,905.6 | 2,905.6 |
| | 44 to 48 | 0.55 J | 8.5 | <0.23 | <0.22 | 190 | 199.1 | 212.9 |
| | 48 to 52 | <4.8 | <1.4 | <2.3 | <2.2 | 680 | 680.0 | 686.9 |
| SP-40 | 36 to 40 | <3.9 | <4.7 | <6.4 | <3.1 | 200 | 200.0 | 200.0 |
| | 40 to 44 | <0.39 | <0.47 | <0.64 | <0.31 | 11 | 11.0 | 13.8 |
| | 44 to 48 | 3.4 | 71 | <0.64 | <0.31 | 2.8 | 77.2 | 95.9 |
| | 48 to 52 | 3.6 | 85 | 0.73 J | 1.3 | 1.6 | 92.2 | 333.0 |
| SP-41 | 36 to 40 | <3.9 | <4.7 | <6.4 | 11 | 1,500 | 1,511.0 | 1,511.0 |
| | 40 to 44 | 2.7 | 26 | <0.64 | 0.76 J | 73 | 102.5 | 119.2 |
| | 44 to 48 | <3.9 | <4.7 | <6.4 | 16 | 1,500 | 1,516.0 | 1,520.4 |
| | 48 to 52 | <3.9 | <4.7 | <6.4 | 13 | 1,200 | 1,213.0 | 1,213.0 |
| SP-42 | 36 to 40 | <0.48 | 0.33 J | <0.23 | <0.22 | 0.51 J | 0.8 | 2.6 |
| | 40 to 44 | <4.8 | <1.4 | <2.3 | 14 | 2,400 | 2,414.0 | 2,425.3 |
| | 44 to 48 | 2.8 | 62 | <0.64 | 0.44 J | 3.4 | 68.6 | 131.6 |
| | 48 to 52 | 2.5 | 69 | <0.64 | 0.81 J | <1.2 | 72.3 | 342.6 |

Notes:

J: J qualifier denotes the concentration is estimated.

bls: below land surface

DCE: Dichloroethene

TCE: Trichloroethene

PCE: Tetrachloroethene

TCLE: Total Chlorinated Ethenes


VOCs: Volatile Organic Compounds

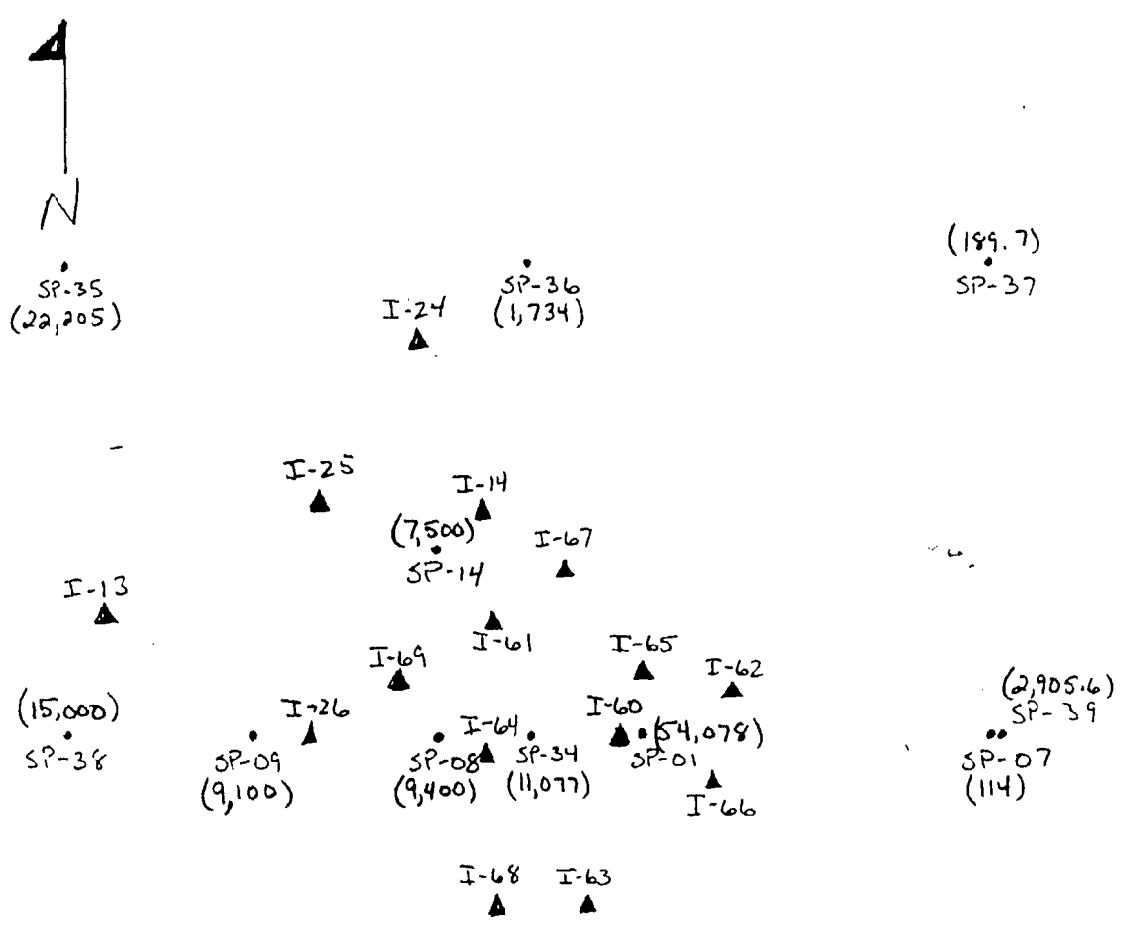
All concentrations reported in micrograms per liter (ug/L)

TCLE is defined as the summation of PCE, TCE, DCE, and Vinyl Chloride.

Total VOCs is defined as the sum of all detected constituents by USEPA Method 8021B.

ATTACHMENT 2
FIGURES

| | | |
|---|---|------|
|  | FIGURE 2-1 SOURCE AREA DELINEATION RESULTS Subject | Date |
| | ORIGINATOR HALIL | Date |
| | SITE INSPECTIONS | Date |



LEGEND:

- SP-01 SAMPLE POINT (WITH TCE CONCENTRATION IN PPB)
- I-60 INTERSECTION WELL
- SP-40 (200)
- SP-03 (2,300)
- SP-41 (1,516)

SCALE: 1" = 10'

HALL

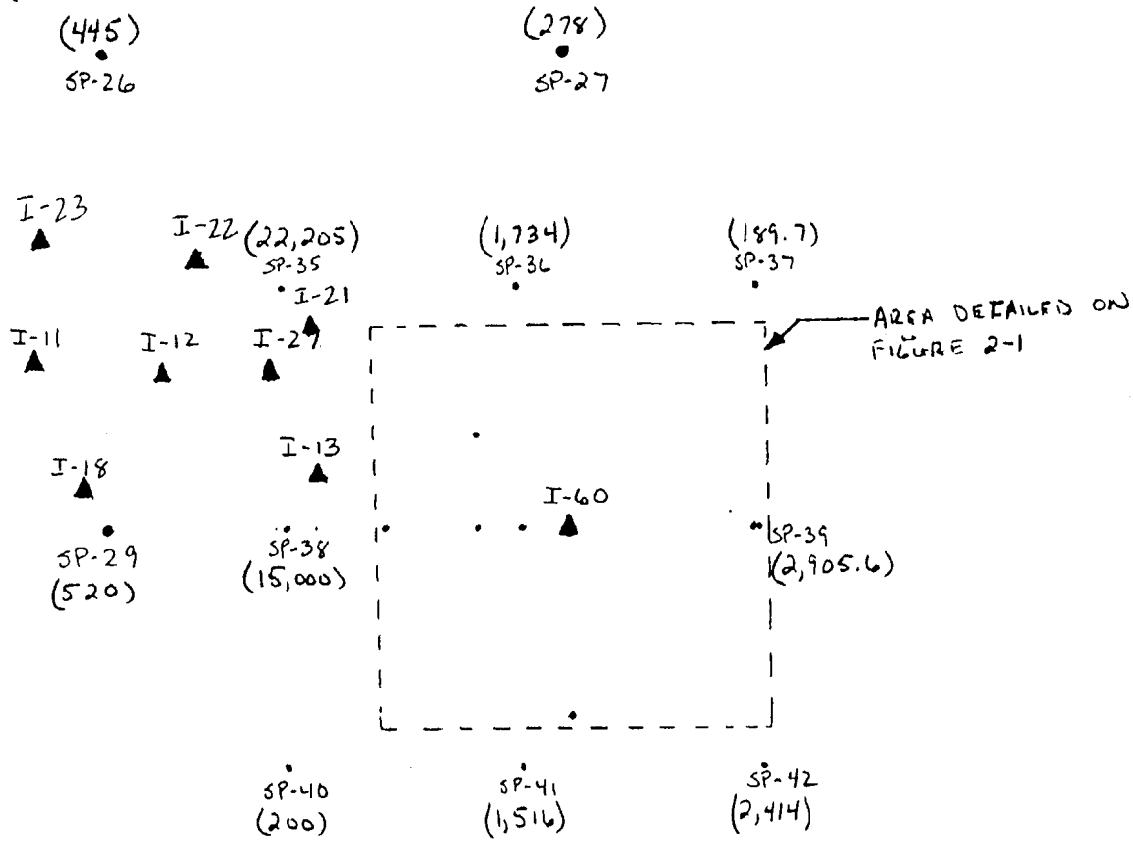
SITE 11 NCE LUGG BAY



LEGEND:

• SAMPLE POINT (with TCE concentration in ppb)

▲ INTERSECTION WELL



SCALE: 1" = 20'